DOCUMENT RESUME

ED 473 399 IR 058 629

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TITLE	The Use of Hypertext and Animation for Online Learning.
PUB DATE	2000-00-00
NOTE	7p.; In: Proceedings of the International Academy for Information Management (IAIM) Annual Conference (15th, Brisbane, Australia, December 6-10, 2000); see IR 058 611.
PUB TYPE	Reports - Research (143) -- Speeches/Meeting Papers (150)
EDRS PRICE	EDRS Price MF01/PC01 Plus Postage.
DESCRIPTORS	*Animation; *Computer Assisted Instruction; *Distance Education; *Hypermedia; Internet; Models; Multimedia Instruction; *Multimedia Materials; Nontraditional Education; Online Systems

ABSTRACT

The research presented in this paper examines the effect of hypertext and animation in the context of online learning. With an increasing number of online courses and degrees offered through the Internet and a rapidly increasing enrollment in such courses, it is important to assess and understand how these online features can affect or contribute toward learning. The paper proposes and tests a model to explain and predict the effect of hypertext and animation on online learning. Preliminary results of the study are reported. Two figures include: research model and experimental design. (Contains 16 references.) (Author)

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ED 473 399

THE USE OF HYPERTEXT AND ANIMATION FOR ONLINE LEARNING

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ABSTRACT

This research examines the effect of hypertext and animation in the context of online learning. With an increasing number of online courses and degrees offered through the Internet and a rapidly increasing enrollment in such courses, it is important to assess and understand how these online features can affect or contribute toward learning. We propose and test a model to explain and predict the effect of hypertext and animation on online learning. Preliminary results of the study are reported.

INTRODUCTION

Currently, the Internet dominates in the development of information and communication technology. The Internet has taken an important role in our daily life by providing a wide range of services including entertainment, education and business. In the field of education, the Internet is used not only to supplement classroom teaching, but also as an increasingly popular medium for delivery of online education courses. An immense amount of research literature and Internet-based teaching modules are added to this network continually. These resources aim towards being a viable alternative for distance learning. According to a survey by the U.S. Department of Education, a total of more than 54,000 online education courses were offered in 1998, with 1.6 million students enrolled (Lewis et al. 1999). Such online courses continue to proliferate very quickly.

Advances in Internet technology have provided users access to not only text and graphics but also digitized audio, video signals, and animations as well. Two online features that have made the Internet more adaptable for education and learning are *Hypertext* and *Animation*.

"Hypertext" is the organization of information units into connected associations that the users can choose to relate at the click of a mouse. Hypertext has been found to be an effective method of training because it provides user flexibility and control over the method, speed, location, and order of information access (Marshall and Shipman

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1995). In this way it caters to a wide range of users who have different goals, interests, requirements and comprehension abilities. Hypertext not only allows students the flexibility to access class information discretely in order to match their pace and personal requirements, but also furnishes students with a knowledge domain through which they can gain/retrieve information at their own pace to match their study order.

Research has shown that individuals comprehend information better with visualization than with written text. One of the simplest forms of visualization is "Animation". Animation refers to computerized simulation of processes using images to form a synthetic motion picture. In the context of learning, Pezdek and his colleague (Pezdek and Stevens 1984; Pezdek 1987) predict that the use of the visual mode of communication effects the human mind to have a higher grasping and retaining capability. Animation is also expected to contribute toward learning since it appeals to the power of the human visual system (Clary, 1997). In Kehoe's (1996) review of studies on animation in education, visual aids are found to have a dramatic positive effect on learning if certain conditions ("explanative text", "sensitive tests", "explanative illustrations", "inexperienced learners") are met (Mayes 1989).

The Internet and its related technologies have provided us with not only a new dimension in education, but also a wider range of teaching and learning styles. With an increasing enrollment in web-based courses and the large amount of resources invested in designing such courses, it is important to investigate how *Hypertext* and *Animation* can influence students' learning behavior and experience, and their subsequent impact on effectiveness of learning. Using the concept of *Flow* (Csikszentmihalyi and Csikszentmihalyi 1988; Hoffman and Novak 1994), we construct a model to explain the effect of hypertext and animation in the online learning environment. Empirical studies are being carried out to test this model.

FLOW THEORY AND CONCEPTS

Flow is the feeling or sensation of enjoyable experiences and the process of optimal experience (Csikszentmihalyi and Csikszentmihalyi 1988). Understanding flow is important in all disciplines and systems -- if a discipline or system can provide the users with sensation of enjoyable experiences, then the users will voluntarily gain increasingly more information from the system and take a more active role in participation. In this manner the more the users enjoy and learn from the experiences the more will be the evolution of the discipline. There have been various definitions and descriptions given to flow. One such description is (Csikszentmihalyi and Csikszentmihalyi 1988 p. 29):

> *Artists, athletes, composers, dancers, scientists and people from all walks of life, when they describe how it feels when they are doing something that is worth doing for its own sake, use terms that are interchangeable in their minutest details. This unanimity suggest that order in consciousness produces a very specific experimental state, so desirable that one wishes to replicate it as often as possible. This particular "state" is given the name "flow."*

Privette and Bundrick (1987) have defined the same term as

> *... an intrinsically enjoyable experience, is similar to both peak experience and peak performance, as it shares the enjoyment of valuing of peak experience and the behavior of peak performance. Flow per se does not imply optimal joy or performance but may include either or both.*

Challenges and skills are the universal preconditions of flow. For flow to occur, it is necessary to have a balance between the level of challenges and the level of skills possessed by an individual in a situation (Csikszentmihalyi and Csikszentmihalyi 1988), and for the flow to be sustained for long these challenges should "become more complex" (Csikszentmihalyi 1982) over time. Csikszentmihalyi (1982) uses the example of a tennis player to illustrate and support the concept of flow. According to Csikszentmihalyi, a tennis player who enjoys the game will improve his/her skills through playing tennis. Now if the challenge imposed by the opponent of this player does not increase/improve, the player will get bored and eventually lose interest unless he/she finds an opponent who offers challenges that meet the improved skills of this player.

Researchers have suggested that flow is a useful construct for describing our interactions with computers (Csikszentmihalyi 1990; Ghani 1991; Ghani and Deshpande 1993; Webster, Trevino, and Ryan 1993). According to Hoffman and Novak (1994), control, content, and motivational characteristics influence four direct determinants of the Flow state: 1) Perceived

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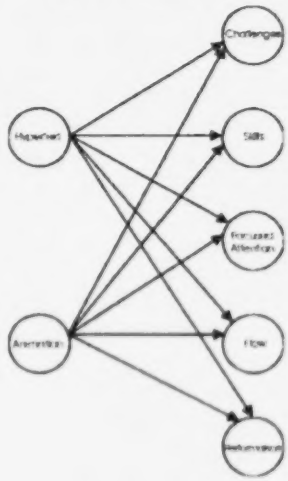
congruence of skills and challenges, 2) Focused attention, 3) Interactivity, and 4) Telepresence. Their model consists of an environment having various exit points. Only perceived congruence (of skills and challenges) and focused attention are examined in this research. The "perceived congruence of skills and challenges" condition is the prerequisite for flow to occur. Once the congruence between skills and challenges is achieved, flow is initiated. It is important to note that in order to sustain this flow state, congruence should always be present. During the flow state, the user experiences enjoyable feelings. At the same time this environment stretches a user's capabilities in learning new skills and enhances his/her "self-esteem and personal complexity" (Hoffman and Novak 1994). Any disparity between skills and challenges will result in the user either exiting the activity or selecting a more congruential activity (i.e., an activity where the user perceives a balance between his/her skills and the challenges offered by the system/activity). In other words, for a system or an activity to provide flow to its users, it should be flexible enough to continually match the skills of the involved users with challenges imposed by the system/activity. The system or activity has to cater to the improving skills of the involved users as they continue using the system or performing the activity.

Focused attention is necessary to induce flow. Focused attention is defined as the "centering of attention on a limited stimulus field" (Csikszentmihalyi 1977). According to Csikszentmihalyi and Csikszentmihalyi (1988), when one is in flow, "one simply does not have enough attention left to think about anything else". The concentration is so immense that the individual does not have any thoughts of being happy or being sad or in fact anything else but the activity. The following is Csikszentmihalyi and Csikszentmihalyi's (1988) description of the flow experience of a young basketball player. While playing the game, s/he completely concentrates in it. Everything that matters to this player is the court. The player forgets or lays aside any other thoughts and feelings of problems such as fighting with his steady girl. This is due to involvement in the activity where the mind is totally concentrating in that activity. Flow can never be experienced if there is no complete involvement or concentration in an activity.

Interactivity is the availability of immediate feedback between entities. This exchange of information and feedback is in form of a sensory dialogue. It is important for an activity to be interactive to induce and maintain flow. In terms of human computer interactions, interactivity can be thought of as an activity where the user requests some action to be performed and the computer responds to that request by taking the appropriate action or displaying the results to the user. An example is that of performing a search on the web using a search engine. To carry out the search, the user will first enter the text to be searched. This text forms the input from the user to the computer. The search engine would respond to the user's request by presenting the search results to the user. The system and activity is interactive because the system output depends on the results of the search. Since our system is a "static" learning module, we will not examine interactivity in this research.

Telepresence is the feeling of being present in a place different from your immediate physical location. Such a feeling is achieved while interacting with a medium such as one involving virtual reality. As hypertext and animation are expected to produce minimal effect, if any, on telepresence, we will not include it in this research.

FIGURE 1
RESEARCH MODEL



PROPOSED MODEL

Our research question is: "How does the inclusion of hypertext and animation effect flow in the online educational environment and what are their implications on effectiveness of learning (measured by performance in a test)?" Our model will focus on the impact of hypertext and animation on skills, challenges, focused attention, flow, and test performance.

Our model hypothesizes that:

(A) *Hypertext decreases challenges, and increases perceived skills, focused attention, flow, and effectiveness of learning (measured by test performance).*

We hypothesize that hypertext will lead to improved perceived congruence of challenges and skills by decreasing challenges in learning the domain and increasing users' perceived skills in the domain. With the availability of hypertexts that provide explanations on difficult terms, the challenge in learning the domain is decreased. Since hypertexts reduce the difficulty in learning the domain by providing explanations on difficult terms, users perceive themselves to have a higher level of skills in the domain. When learning a new or challenging domain, the perceived congruence between challenges and skills will be improved by decreasing the perceived challenges and increasing the users' perceived skills in the domain. By increasing the ease and convenience of accessing explanations on difficult terms, users are also more likely to stay focus on the learning process and in using the learning module. When perceived congruence (of challenges and skills) and focused attention are achieved, flow occurs. With greater flow and focused attention on the learning module, effectiveness of learning will improve.

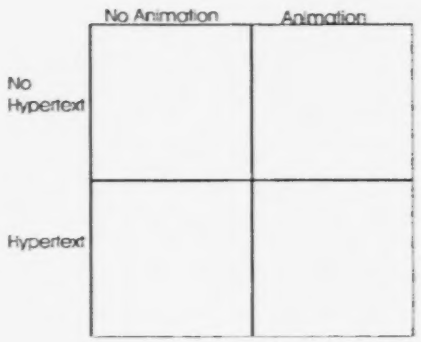
(B) *Animation decreases challenges, and increases perceived skills, focused attention, flow, and effectiveness of learning (measured by test performance).*

Similarly, providing animations of the concepts covered in the learning module decreases the challenges in learning the domain and increases the users' perceived skills. Since the domain is made more interesting to learn through animations, focused attention will increase, which further leads to flow. We hypothesize that effectiveness of learning will improve by providing visualizations of difficult concepts in the domain and through increased flow and focused attention.

RESEARCH DESIGN AND METHODOLOGY

Figure 2 presents the proposed experimental design for the study. An Internet teaching module — developed for the department of Agronomy at the University of Nebraska-Lincoln — will be adapted for this experiment. The module presents the fundamentals of plant genetics and is targeted towards distance learning students in the field of Agriculture. For this experiment, we will recruit only novice subjects who have no prior knowledge of plant genetics. These subjects will be randomly assigned to one of the four experimental conditions.

FIGURE 2
EXPERIMENTAL DESIGN



The teaching module presents basic principles of plant genetics and provides a glossary of terms in plant genetics. In the hypertext version of the module, the users only need to click on the term (or more specifically, the hypertext link associated with the term) to access explanations on the term. The explanations are presented in a small Internet browser pop-up window. All the information that is available through these hypertext links is also available in the system's "glossary document". In the non-hypertext version of the module, the users will have to separately access the "glossary document" and search for the specific term to access explanations on the term. Thus, the provision of hypertext links facilitates the search process by making the explanations more "easily accessible."

In the animated version of the teaching module, animations of various processes are presented along with the text. These animations are in addition to the regular graphics, diagrams and photographs that are embedded in the text. In the non-animated version, these processes are shown in a static manner. Thus, the use of animations provides a richer mode of communicating and expressing the textual and "static graphical" information to the users.

Study data will be collected using a questionnaire administered at the end of the study and through computer logs.

PRELIMINARY RESULTS

We analyzed the data collected using MANOVA. Interestingly, none of our hypotheses are supported. Contrary to our hypotheses, hypertext has a negative impact on the dependent variables in the study ($p<.05$) while animation does not produce any significant impact on the dependent variables. We suspect the reason may be due to the small statistical power of the study. Even with a large effect size ($f=.40$), the power attained is only .60. When analyzing at a medium effect size of $f=.25$, the power is only .28. Hence, the contrary and insignificant results may be due to Type II error. In future research, we will carry out this study with a larger sample size to assess the effect of hypertext and animation on the dependent variables proposed.

EXPECTED CONTRIBUTION

This research assesses the degree to which Hypertext and Animation contribute toward learning in the online environment. More specifically, it examines how Hypertext and Animation influence challenges, perceived skills, focused attention, flow and effectiveness of learning. From a research standpoint, this study investigates and explains how the provision of hypertext and animation impact on effectiveness of learning. From an application standpoint, the results will be extremely useful to educators, designers, and developers of web-based training courses. With an increased understanding of the effect of online features on learning, web designers and programmers can develop better and more effective online training modules by focusing their time and attention on incorporating features that contribute toward effectiveness of learning.

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